Supplementary Table 1: PRISMA 2020 checklist.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Page 2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 4
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 3
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Page S4
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Page 4
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Page 4
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 4
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 4
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 4
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 4
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 4
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Page 4

Section and Topic	Item #	Checklist item	Location where item is reported
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Page 4
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Page 4
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 5
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Page 5
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Page 4
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 4
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 6
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 6
Study characteristics	17	Cite each included study and present its characteristics.	Page 6,15
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Page 6
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Page 6-7
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Page 6-7
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Page 6-7
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Page 7
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Page 7
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Page 7
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Page 7
DISCUSSION			

Section and Topic	Item #	Checklist item	Location where item is reported
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 8-9
	23b	Discuss any limitations of the evidence included in the review.	Page 9
	23c	Discuss any limitations of the review processes used.	Page 9
	23d	Discuss implications of the results for practice, policy, and future research.	Page 9
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 3
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 3
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Page 3
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Title page
Competing interests	26	Declare any competing interests of review authors.	Title page
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Page 16

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

Supplementary Table 2: Search strategy.

PubMed	(coronavirus[Title/Abstract] OR "corona virus" [Title/Abstract] OR "corona pandemic"[Title/Abstract] OR coronavirinae[Title/Abstract] OR coronaviridae[Title/Abstract] OR betacoronavirus[Title/Abstract] OR covid19[Title/Abstract] OR covid[Title/Abstract] OR nCoV[Title/Abstract] OR "CoV 2"[Title/Abstract] OR CoV2[Title/Abstract] OR sarS2[Title/Abstract] OR sarscoV2[Title/Abstract] OR 2019nCoV[Title/Abstract] OR "novel CoV"[Title/Abstract] OR "COVID-19" [Supplementary Concept]) AND ("severe acute respiratory"[Title/Abstract] OR pneumonia[Title/Abstract] OR "infection"[Title/Abstract] OR "respiratory infectious disease"[Title/Abstract]) AND ("Reinfection"[Mesh] OR secondary infection[Title/Abstract]) Filters: Humans, from 2020 - 2021
Scopus	TITLE-ABS-KEY (coronavir* OR "corona virus" OR "corona pandemic" OR betacoronavir* OR covid19 OR covid OR ncov OR "CoV 2" OR coV2 OR sarscoV2 OR sarS2 OR 2019ncov OR "novel CoV") OR TITLE-ABS-KEY(sars AND cov) AND (TITLE-ABS-KEY ("severe acute respiratory" OR pneumonia* OR infection OR "respiratory infectious disease")) AND (TITLE-ABS-KEY (reinfection* OR "secondary infection")) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020)) AND (LIMIT-TO (DOCTYPE , "ar"))
Embase	((ncov OR (('coronavirus' OR 'coronavirus'/exp OR coronavirus) AND ('wuhan' OR 'wuhan'/exp OR wuhan)) OR 'novel coronavirus' OR 'covid' OR 2019ncov OR 'sars-cov'/exp OR 'sars-cov' OR 'covid'/exp OR covid OR (('coronavirus' OR 'coronavirus'/exp OR coronavirus) AND novel) OR 'corona virus':ti,ab OR 'coronavirus':ti,ab OR hcov OR 'sars virus'/exp OR 'sars virus' OR 'coronavirus disease 2019'/exp OR 'coronavirus disease 2019' OR 'novel coronavirus pneumonia' OR 'covid 19 virus' OR 'severe acute respiratory syndrome coronavirus 2'/exp OR 'severe acute respiratory syndrome coronavirus 2' OR 'coronavirinae'/exp OR 'coronavirinae' OR 'coronavirus infection'/exp OR 'coronavirus infection' OR 'covid19' OR 'covid19'/exp OR covid19 OR covid2019 OR 'corona pandemic' OR 'sarscov 2' OR 'sarscov-2' OR 'sars co v 2' OR coivd OR 'sars voc') AND ('severe acute respiratory':ab,ti OR pneumonia:ab,ti OR infection:ab,ti OR 'respiratory infectious disease':ab,ti) AND ('reinfection'/exp OR 'secondary infection':ab,ti) AND [2020-2021]/py AND 'human'/de
Web of science	(TI=coronavirus OR TI=covid OR TI=Covid19 OR TI=ncov OR TI=(SARS NEAR/3 COV) OR TI="novel coron*virus" OR TI=2019*ncoV OR TI=2019ncov OR TI=(CORON*VIRUS NEAR/3 (OUTBREAK OR pandemic OR 2019 OR new OR novel)) OR TI=coronavirinae OR TI=coronaviridae OR TI=betacoronavirus OR TI =SarS2 OR TI=COV2 OR TI="corona pandemic") AND (TI="severe acute respiratory" OR TI=pneumonia OR TI=infection OR TI="respiratory infectious disease") AND (TI=reinfection* OR TI=secondray infection) Refined by: PUBLICATION YEARS: (2021 OR 2020) AND [excluding] Databases: (MEDLINE). Search language=Auto.
Cochrane Library	((coronavirus or covid or covid19 or ncov or coronavirinae or coronaviridae or betacoronavirus or SarS2 or COV2 or "novel coron*virus" or 2019*ncoV or 2019ncov):ti,ab,kw) AND (("severe acute respiratory" or pneumonia or infection or "respiratory infectious disease"):ti,ab,kw) AND ((reinfection* or "secondary infection"):ti,ab,kw) Custom year range:2020-2021

Supplementary Table 3: Comparison of the number of initial positive infections and the number of initial negative infections.

Study (year)	Reinfection/ symptomatic reinfection (n)	Initial positive infection (n)	Infection/ symptomatic infection (n)	Initial negative infection (n)	HRP reinfection (n)	Initial positive infection in the HRP (n)
Jeffery-Smith (2021)	1/0	88	22/NA	73	1	44
Lumley (2021)	3/1	1265	223/123	11276	3	1265
Hansen (2021)	72/NA	11068	16819/NA	514271	8	658
Abu-Raddad (2020)	54/23	133266	NA/NA	NA/NA	NA	NA
Harvey (2021)	125/NA	41587	8212/NA	273735	NA	NA
Graham (2021)	304/249	36509	NA/NA	NA/NA	NA	NA
Soriano (2021)	2/NA	122	NA/NA	NA/NA	NA	NA
Breathnach (2021)	8/NA	10727	713/NA	55274	NA	NA
Zare (2021)	9/9	4039	NA/NA	NA/NA	3	NA
Hanrath (2021)	0/0	1038	312/290	10137	0	1038
Sheehan (2021)	62/31	8845	5449/3191	141480	NA	NA
Qureshi (2021)	63/19	9119	NA/NA	NA/NA	NA	NA
Dubelbeiss (2021)	3/0	45	NA/NA	NA/NA	NA	NA
Sanchez-Montalva (2021)	3/0	20	NA/NA	NA/NA	3	20
Abu-Raddad (2021)	129/NA	43044	3185/NA	149923	NA	NA
Hall (2021)	155/78	8278	1704/1369	17383	NA	NA
Pilz (2021)	40/NA	14840	253581/NA	8885640	NA	NA
Mukherjee (2021)	58/32	1300	NA/NA	NA/NA	12	NA
Cavanaugh (2021)	5/5	25	NA/NA	NA/NA	5	25

HRP: high-risk population; NA: not available

Reinfection rate= $\frac{\text{reinfections}}{\text{intial positive patients}}$; Symptomatic reinfection rate=$\frac{\text{symptomatic reinfections}}{\text{intial positive patients}}$; HRP reinfection rate=$\frac{\text{HRP reinfections}}{\text{intial positive patients in the HRP}}$

Protection against reinfection=$1-\frac{\text{reinfections}}{\text{intial positive patients}}/\frac{\text{infections}}{\text{intial negative patients}}$;

Protection against symptomatic reinfection=$1-\frac{\text{symptomatic reinfections}}{\text{intial positive patients}}/\frac{\text{symptomatic infections}}{\text{intial negative patients}}$

Supplementary Table 4: Newcastle-Ottawa Scale assessment results of cohort studies.

Author name: Jeffery-Smith (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Lumley (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	**
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Hansen (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	*
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	**
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Abu-Raddad (2020)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	*
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	

Author name: Harvey (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	*
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	**
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Soriano (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	

Author name: Breathnach (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	*
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Zare (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Hanrath (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	**
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	

Author name: Sheehan (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	**
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	

Author name: Qureshi (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	**
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Dubelbeiss (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Sanchez-Montalva (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	*
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Abu-Raddad (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	*
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	

Author name: Hall (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	**
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	

Author name: Pilz (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	*
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Author name: Cavanaugh (2021)	
Items	**Response options**
Selection	
Representativeness of the exposed cohort	
Selection of the non exposed cohort	*
Ascertainment of exposure	*
Demonstration that outcome of interest was not present at start of study	*
Comparability	
Comparability of cohorts on the basis of the design or analysis	
Outcome	
Assessment of outcome	*
Was follow-up long enough for outcomes to occur	*
Adequacy of follow up of cohorts	*

Cohort studies with scores of 0-3, 4-6, 7-9 were, respectively, considered as low, moderate, and high quality.

Joanna Briggs Institute critical appraisal tool assessment results of ecological and cross-sectional studies

Author name: Graham (2021)	
Items	**Response options**
1. Were the criteria for inclusion in the sample clearly defined?	**Y**
2. Were the study subjects and the setting described in detail?	**Y**
3. Was the exposure measured in a valid and reliable way?	**Y**
4. Were objective, standard criteria used for measurement of the condition?	**Y**
5. Were confounding factors identified?	**N**
6. Were strategies to deal with confounding factors stated?	**N**
7. Were the outcomes measured in a valid and reliable way?	**Y**
8. Was appropriate statistical analysis used?	**Y**

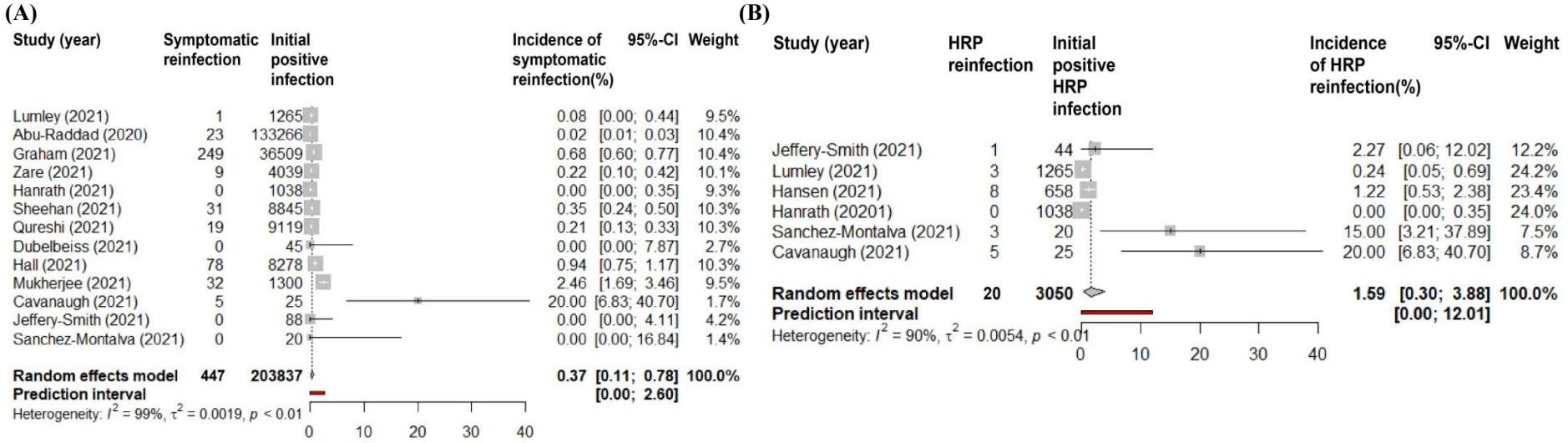
Author name: Mukherjee (2021)	
Items	**Response options**
1. Were the criteria for inclusion in the sample clearly defined?	**Y**
2. Were the study subjects and the setting described in detail?	**Y**
3. Was the exposure measured in a valid and reliable way?	**Y**
4. Were objective, standard criteria used for measurement of the condition?	**Y**
5. Were confounding factors identified?	**N**
6. Were strategies to deal with confounding factors stated?	**N**
7. Were the outcomes measured in a valid and reliable way?	**Y**
8. Was appropriate statistical analysis used?	**Y**

We arbitrarily defined the study at high quality if it clearly described study subjects and the setting, identified and deal with the confounding factors, and all other items were assessed as Yes or NA; at low quality if it were not met all three criteria, regardless of assessment of other items; at moderate quality if it did not meet criteria for high or low quality.

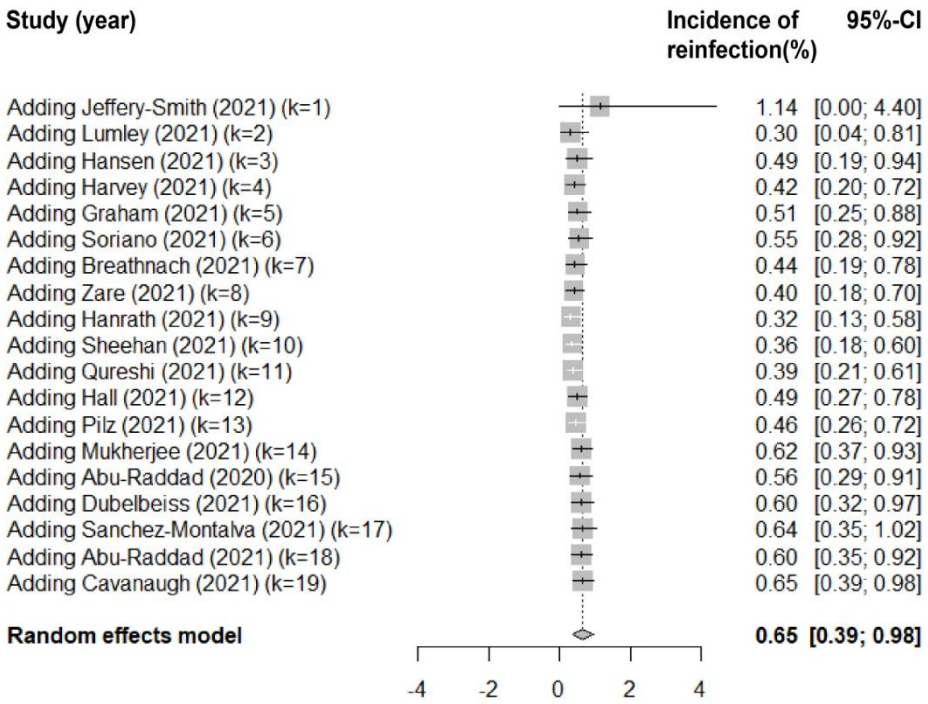
Supplementary Table 5: The quality of evidence of each outcome of interest based on GRADE assessment tool.

Number of study (Study design)	**Limitations** -No serious -Serious -Very serious	**Inconsistency** -No serious -Serious -Very serious	**Indirectness** -No serious -Serious -Very serious	**Imprecision** -No serious -Serious -Very serious	**Publication bias** -Detected -Undetected	**Quality of evidence** -High -Moderate -Low -Very low
Reinfection rate						
19 observational studies	Serious	Serious	No serious	No serious	Detected	Low
Symptomatic reinfection rate						
11 observational studies	Serious	Serious	No serious	No serious	Detected	Low
Reinfection rate for HRP						
6 observational studies	Serious	Serious	No serious	No serious	Detected	Low
Protection against reinfection						
10 observational studies	Serious	Serious	No serious	No serious	Detected	Low
Protection against symptomatic reinfection						
3observational studies	No serious	No serious	No serious	No serious	Undetected	Moderate

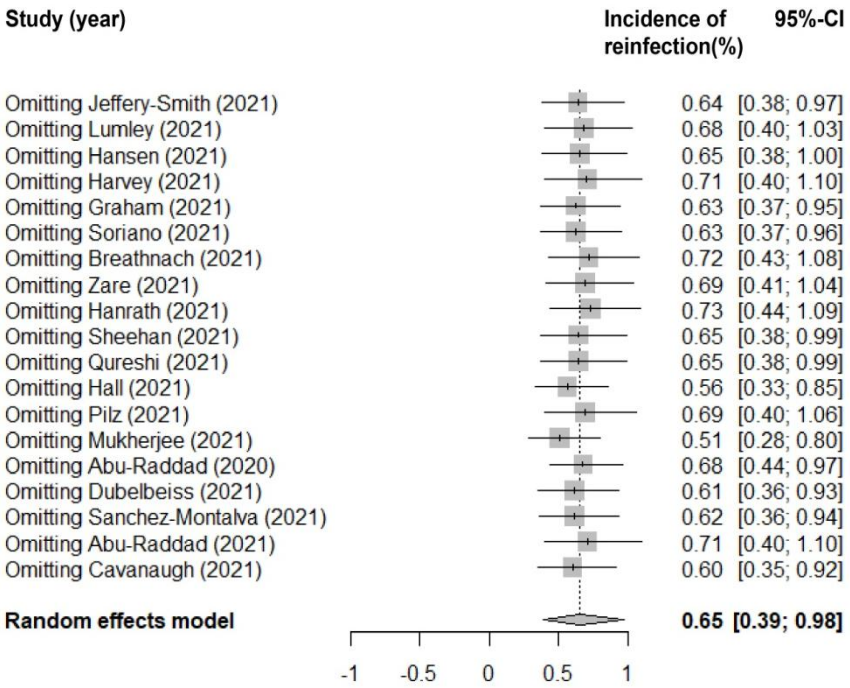
HRP: High-risk population.



Supplementary Figure 1: Forest plot illustrating the summary incidence of SARS-CoV-2 reinfection in specific settings. **(A)** Symptomatic reinfection, **(B)** HRP reinfection. CI: Confidence interval; HRP: High-risk population; SARS-CoV-2: Severe acute respiratory syndrome Coronavirus 2.



Supplementary Figure 2: Cumulative meta-analysis for reinfection rate. CI: Confidence interval.



Supplementary Figure 3: Sensitivity analysis for reinfection rate. CI: Confidence interval.